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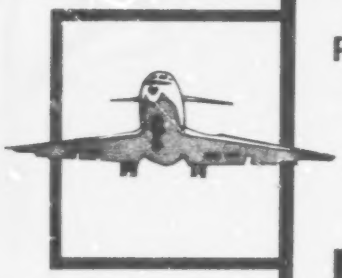

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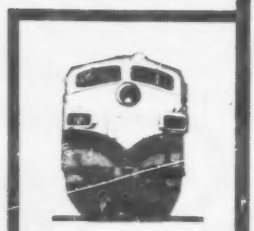
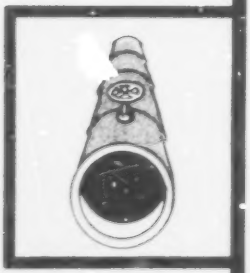


WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

LOSS BY FIRE OF THE U. S. PASSENGER VESSEL M/V FANTASY ISLANDER IN CHARLOTTE HARBOR, FLORIDA SEPTEMBER 8, 1984



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16. Abstract

On September 8, 1984, the 42-foot passenger vessel M/V FANTASY ISLANDER was returning to Fishermen's Village, Punta Gorda, Florida, after a sightseeing/luncheon cruise to Cabbage Key in Charlotte Harbor. About 1545, a fire, which started in the engine compartment, forced the 2 crewmembers and 35 passengers to abandon the vessel about 0.5 nautical mile off Punta Gorda. There were no injuries. The vessel, which was a total loss, was valued at about $25,000.

The National Transportation Safety Board determines that the probable cause of the destruction by fire of the FANTASY ISLANDER was the failure of the operator to investigate immediately when he detected the odor of burning wood and to take early measures to extinguish a smoldering fire in fuel soaked insulation. The leakage of residual fuel into the surrounding insulation and its ignition were caused by undetected deterioration of the flexible piping in the dry exhaust system. Contributing to the spread of the fire was the failure of the operator to shut down the starboard engine immediately when he detected fire, oil spray from an undetermined source in the vicinity of the starboard engine which fueled the fire, and the operator's failure to use all available firefighting equipment to confine and control the fire.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

Adopted: July 30, 1985

LOSS BY FIRE OF THE U.S. PASSENGER M/V FANTASY ISLANDER IN CHARLOTTE HARBOR, FLORIDA SEPTEMBER 8, 1984

INTRODUCTION

This accident was investigated jointly by the National Transportation Safety Board and the U.S. Coast Guard. Public hearings were held on September 25, 26, and on October 23, 1984, in Fort Myers, Florida. This report is based on the evidence developed in the investigation. The Safety Board has considered all facts pertinent to the Safety Board's statutory responsibility to determine the cause or probable cause of the accident and to make recommendations.

The Safety Board's analysis and recommendations are made independently of the Coast Guard. To inform the public of all Safety Board recommendations and the responses to the recommendations, a notice of all recommendations and the responses is published in the Federal Register.

SYNOPSIS

On September 8, 1984, the 42-foot passenger vessel M/V FANTASY ISLANDER was returning to Fishermen's Village, Punta Gorda, Florida, after a sightseeing/luncheon cruise to Cabbage Key in Charlotte Harbor. About 1545, a fire, which started in the engine compartment, forced the 2 crewmembers and 35 passengers to abandon the vessel about 0.5 nautical mile off Punta Gorda. There were no injuries. The vessel, which was a total loss, was valued at about $25,000.

The National Transportation Safety Board determines that the probable cause of the destruction by fire of the FANTASY ISLANDER was the failure of the operator to investigate immediately when he detected the odor of burning wood and to take early measures to extinguish a smoldering fire in fuel soaked insulation. The leakage of residual fuel into the surrounding insulation and its ignition were caused by undetected deterioration of the flexible piping in the dry exhaust system. Contributing to the spread of the fire was the failure of the operator to shut down the starboard engine immediately when he detected fire, oil spray from an undetermined source in the vicinity of the starboard engine which fueled the fire, and the operator's failure to use all available firefighting equipment to confine and control the fire.

INVESTIGATION

The Accident

On Saturday, September 8, 1984, the M/V FANTASY ISLANDER, a 42-foot passenger vessel, owned and operated by the King Fisher Cruise Lines, Inc., was berthed

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at Fisherman's Village, Punta Gorda, Florida. The vessel embarked 35 adult passengers for a sightseeing/luncheon cruise to Cabbage Key in Charlotte Harbor and departed its berth at 0900. 1/ (See figure 1.)

While proceeding outbound in the Peace River and into Charlotte Harbor, the operator used the public address system to inform the passengers about the vessel's lifesaving devices and their location on board and to narrate for 30 to 40 minutes concerning points of interest along the route. Meanwhile, the "mate," the only other crewmember, distributed menus and took luncheon orders from the passengers. The mate subsequently transmitted the luncheon orders and the estimated time of arrival by radiotelephone to the dining facility at Cabbage Key.

The passengers were accommodated on the vessel on seats in the forward cabin, the main cabin, the cockpit, and the flying bridge. Some passengers complained to the mate about the "black" exhaust fumes emanating from the starboard engine exhaust stack which extended vertically upward from the cockpit deck. The mate explained that the fumes would be less noticeable after the vessel entered Charlotte Harbor.

When the vessel neared navigation marker 5 off Cape Haze, the operator resumed narrating and continued until the vessel berthed at Cabbage Key, about 1130. After berthing, the passengers and the crew went ashore for lunch and sightseeing.

At 1330, the passengers reembarked and the FANTASY ISLANDER departed Cabbage Key for the return trip to Fishermen's Village. The operator stated that the wind was strong from the northeast, that the harbor water became rough, and that the vessel began to take spray over the bow as it neared marker 5. Some passengers again complained about the engine exhaust fumes which caused some passengers' eyes to water and to become red and several passengers to become nauseous.

The operator testified that about 1500, when the FANTASY ISLANDER was near the center of Charlotte Harbor, he detected the odor of burning wood which seemed to come from the starboard exhaust side of the vessel. Because of a prior fire, he suspected that wood was burning in the vicinity of the starboard exhaust pipe where flexible tubing passed through the engine compartment wooden after bulkhead and curved upward to the exhaust muffler.

Since the vessel was near the halfway point of the return trip, the operator opted to continue at full speed, about 10 knots, to reach the shelter of the Peace River or the berth at Fishermen's Village. He stated that he considered stopping the starboard engine, but doing so would have cut the vessel's speed by one-half and would have delayed arrival. The operator reasoned that there would be more vessels located in the river area to provide assistance if it was needed, and that there was a fire hydrant located close to the vessel's berth. Fearing passenger panic if a fire broke out, he directed the mate to talk to the passengers and to keep them calm. The operator stated that he hesitated to open and inspect the engine compartment because doing so would allow more air into the compartment and that might cause what he believed to be smoldering wood to ignite.

After a while, he had the mate take over steering the vessel while he left the flying bridge and proceeded to the engine compartment to assess the situation. He testified that he put a towel into the starboard forward half-vent to partially block the entry of air into

1/ All times are eastern daylight time, based on the 24-hour clock.

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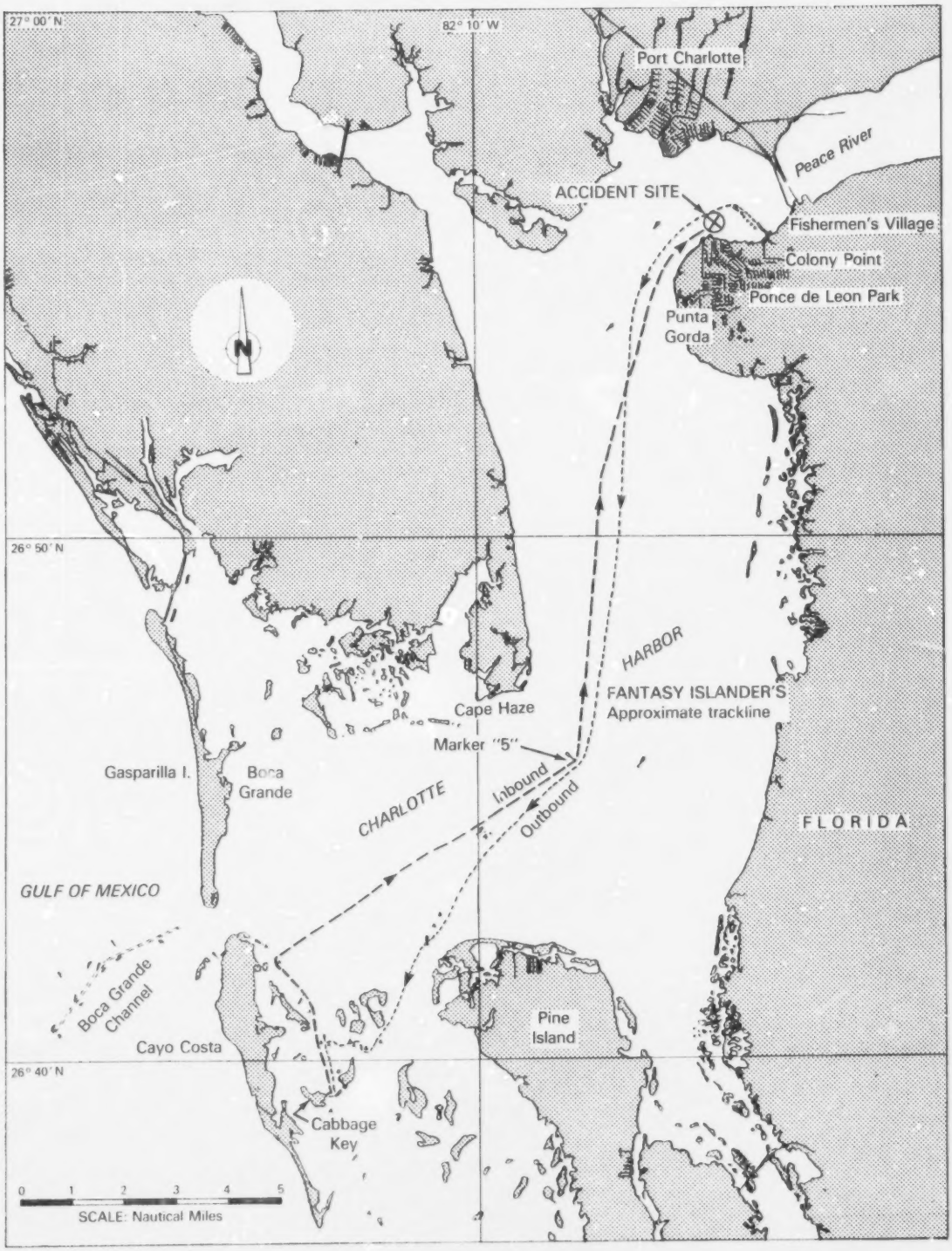

Figure 1.--Location of the accident.

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the engine compartment and then entered the main cabin and opened the life preserver cabinet located at the after starboard side, where he found some life preservers smoldering. He then removed about 11 life preservers, soaked them with water, restowed them, and closed the cabinet door. He stated that he did not believe it wise to leave the life preservers out because they were no longer suitable for use. He then returned to the flying bridge, relieved the mate at the wheel, and instructed the mate again to go below and talk to the passengers. The operator stated that he considered having the passengers don life preservers about that time, but that he was afraid if he did so some of the passengers might panic and jump overboard while the vessel was still a considerable distance from shore. He stated also that the recovery of such passengers would have been difficult and would have delayed the vessel's return to port. There was no evidence that any of the passengers sensed the danger and considered donning life preservers of their own volition.

When the mate entered the main cabin, she saw smoke escaping from the cabinet containing the life preservers. One of the passengers commented to the mate, "I think we're in trouble," and the mate agreed. The mate then returned to the flying bridge and reported the smoke to the operator. The operator responded that he was aware of the problem and told the mate to return below and continue talking to the passengers. The mate went below through the forward hatch and stood on the forward ladder while she attempted to reassure the passengers about the fumes which, by this time, had permeated the cabins.

About 1545, when the FANTASY ISLANDER was off Colony Point, a passenger in the main cabin shouted "We've got a fire down here." The operator stated that he immediately turned the wheel to the right to head the vessel toward shore, and that he shut off the throttles controlling the engines. The port engine stopped immediately, but the starboard engine "became a runaway." The operator then went below and opened the engine compartment hatch cover to shut off the starboard engine by means of the emergency air shutdown control lever. The operator stated that because of black smoke pouring from the engine compartment and hot oil spraying in the vicinity of the engine, he was unable to locate the emergency control lever. He then went into the cockpit and closed both emergency fuel line shutoff valves which were located there. The starboard engine continued to run "screaming" for 2 to 3 minutes.

After closing the fuel line shutoff valves, the operator looked through the engine compartment hatch and saw that there were flames in the after starboard side of the compartment. The mate handed the operator two CO_2 fire extinguishers from the forward cabin which the operator applied to the fire. The CO_2 only temporarily extinguished the flames. The operator then used a third CO_2 extinguisher, but the fire reignited and began to spread, burning out of control.

A hand operated fire pump, which the operator described as a "toy," and its hoses were stowed unassembled in the forward cabin. The operator said that he did not use this fire equipment because it would have required assembly and stopping the vessel to put a suction hose over the side into the water. He stated that a 5-gallon bucket would have been more useful but there was none onboard this trip.

As the fire spread, smoke began to fill the cabins, so the operator directed the passengers from the cabins and the cockpit onto the forward deck. Meanwhile, with the operator's permission, the mate went to the flying bridge and transmitted on the VHF-FM radiotelephone, channel 16, "Fishermen's Village, this the FANTASY ISLANDER. . .we're on fire right off Colony Point, I've got big problems can you get out here pretty quick."

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The Coast Guard radio tape of channel 16 communications shows that the message originated at 1549. As recorded on the tape, the interchange of communications with Fishermen's Village was broken and distorted by other communications in the area until 1553.

Passenger Rescue

The operator of the SS SHARING SHIP, a 28-foot pontoon pleasure boat, saw black smoke billowing from the FANTASY ISLANDER, which was about 2 miles distant. At the time, the operator, his wife, and four children were cruising the waterway at Punta Gorda. The operator of the SHARING SHIP maneuvered his boat at full speed to render assistance. He stated that while proceeding toward the FANTASY ISLANDER, he attempted to broadcast a Mayday message on VHF-FM radiotelephone channel 16, but he dropped the microphone in the process and did not send a complete message as to the location of the distressed vessel.

Upon arriving at the FANTASY ISLANDER, he positioned the SHARING SHIP port side to the burning vessel's port quarter. The SHARING SHIP's operator stated that the FANTASY ISLANDER's operator said that he had a runaway engine and asked for a fire extinguisher. A small fire extinguisher was handed over but it was not used because the FANTASY ISLANDER's operator was using a larger one. The SHARING SHIP's operator stated that the FANTASY ISLANDER's engine then "quit," and flames erupted 30 to 60 seconds later. Immediately afterward, 24 of the FANTASY ISLANDER's passengers transferred to the SHARING SHIP which had a rated capacity for only 16 persons. With 30 persons on board, the SHARING SHIP's pontoons and deck became awash because of the passenger overload. While the passengers were being transferred, someone aboard the FANTASY ISLANDER said, "It's going to blow up." Consequently, the SHARING SHIP's operator maneuvered his boat away from the burning vessel. The SHARING SHIP's operator stated that there was no panic among the FANTASY ISLANDER's passengers, and that they obeyed his orders immediately and calmly.

The FANTASY ISLANDER's operator then directed the remaining passengers to the forward deck, where the mate, with passenger assistance, launched the FANTASY ISLANDER's 15-person lifefloat 2/ on a tether over the port side. The operator then ordered the remaining passengers into the water. The operator stated that while the passengers were abandoning the vessel, he broadcast a Mayday on channel 16; there is no record of this broadcast on the channel 16 radio tape. Because two elderly passengers, a male and a female, could not swim, the operator helped them into the water while he clung to the anchor marker line which was secured at the vessel's bow. The two elderly passengers subsequently were assisted to the lifefloat. Neither the 2 crewmembers nor the 11 remaining passengers were wearing life preservers when they abandoned the FANTASY ISLANDER about 1600. (See figure 2.)

After the FANTASY ISLANDER was abandoned, it drifted downwind along Colony Point, trailing the lifefloat with the 13 persons tethered to the vessel with a 100-foot line. The SHARING SHIP circled toward the FANTASY ISLANDER en route to Colony Point, about 1 mile distant. Several life preservers were thrown from the SHARING SHIP as it passed the FANTASY ISLANDER's passengers in the water. When the SHARING

2/ Lifesaving flotation equipment designed to support persons in the water. It is of lightweight rigid construction, usually elliptical in shape, and may be used either side up. Persons may be supported inside, by netting, partially immersed, or outside fully immersed by holding onto lifelines secured about the periphery of the float.

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Figure 2.—The burning FANTASY ISLANDER.

SHIP neared Colony Point, it grounded and some of the passengers had to wade ashore. The operator was then able to maneuver the lightened boat to within 30 yards of the shoreline where the remaining FANTASY ISLANDER passengers waded ashore. Passengers were assisted by local residents, police, and an ambulance crew which had arrived on scene. The operator of the SHARING SHIP then headed his boat back to the FANTASY ISLANDER to offer further assistance.

Meanwhile, the sailboat ADMIRAL TAWSEY, proceeding to assist the FANTASY ISLANDER, broadcast on VHF-FM channel 16 about 1557 that it had no engine but would sail nearby and drop anchor so that passengers abandoning the stricken vessel could swim to it. The ADMIRAL TAWSEY was maneuvered close to the FANTASY ISLANDER and several flotable cushions were thrown to persons in the water. The ADMIRAL TAWSEY took aboard two persons from the water and then anchored. About 1610, the operator broadcast on channel 16 that he had two FANTASY ISLANDER passengers on board. The Coast Guard Auxiliary at Charlotte Harbor responded, thanked the "skipper" of the ADMIRAL TAWSEY for his assistance, and advised that Coast Guard Auxiliary boats were expected to arrive on scene "very shortly." The nearest Coast Guard station was at Fort Myers, Florida, 30 nmi distant. Meanwhile, a 16- to 17-foot outboard motor boat which arrived at the FANTASY ISLANDER's lifefloat took aboard two passengers from the water. Two other vessels planning to offer assistance interrupted channel 16 communications to request information on the location of Colony Point, which is not shown on the chart of the area, but neither vessel was located at a position to readily help the FANTASY ISLANDER.

Shortly afterward, the KING FISHER II, of King Fisher Cruise Lines, Inc., arrived on scene, took aboard the FANTASY ISLANDER's passengers and crewmembers from the water and the assisting vessels, recovered the FANTASY ISLANDER's lifefloat, and proceeded to Fishermen's Village.

Firefighting Assistance

The Port Charlotte Fire Department was notified by telephone of the fire aboard the FANTASY ISLANDER at 1604 and responded by dispatching a 21-foot firefighting boat with a crew of four to the scene. The boat was trailered overland and launched at Port Charlotte Beach, located about 1.5 nmi northward of the FANTASY ISLANDER's position. The boat arrived at the FANTASY ISLANDER at 1618. By 1639, the firemen had extinguished the fire using harbor water pumped through a 1 1/2-inch-diameter hose. The firemen then towed the FANTASY ISLANDER toward Punta Gorda where they beached it near Ponce De Leon Park.

Postaccident Events

The operator boarded the FANTASY ISLANDER after it was beached, dropped an anchor to hold the vessel in position, and then plugged all hull openings in the vessel to prevent flooding. On September 9, the owners of the FANTASY ISLANDER boarded the vessel, pumped the hull free of water, and refloated it. The vessel was then towed to the Riviera Marina, located within the waterway at Punta Gorda, where it was removed from the water.

Injuries to Persons

Injuries	Crew	Passengers	Total
Fatal	0	0	0
Nonfatal	0	0	0
None	2	35	37
Total	2	35	37

Damage to Vessel

The FANTASY ISLANDER's interior wooden structure and portions of the hull and main deck were consumed by fire. (See figure 3.) The starboard outer hull near the waterline had a localized paint discoloration, apparently from internal heat, in the vicinity of the exhaust pipe leading to the muffler. The vessel was a total loss estimated to be about $25,000.

Crew Information

The operator had 2 1/2 years experience in cruise business and was a co-owner of King Fisher Cruise Lines, Inc., which began operations in August 1982. In addition to serving as a vessel operator, he performed most of the routine maintenance on the vessels which the company operated. The operator testified that the did not use drugs, drink alcohol or coffee, and did not smoke tobacco; he also stated that he had a full night of rest before the accident.

The mate's work on the FANTASY ISLANDER consisted of cleaning the vessel to receive passengers, putting cushions on seats, assisting passengers, taking luncheon orders, handling mooring lines while docking and undocking, and occasionally relieving the operator at the steering wheel while the vessel was underway. The operator stated that he expected the company's mates to be able to maneuver the boats into and out of the berths and that he had trained mates to do so.

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Figure 3.--The burned hull of the FANTASY ISLANDER.

The mate stated that she had witnessed three fires between January and the beginning of summer 1984 aboard the FANTASY ISLANDER, all of which were located on the starboard side. One fire had "burned a small hole through the deck," another had scorched a couple of life preservers, and the third fire had occurred in the starboard "crawl space" below the cockpit deck while departing Cayo Costa; the passengers had to leave the vessel while the operator used a hand fire pump and a long hose to extinguish the fire with water, taking a half-hour to do so.

The mate stated that she believed the "boat [the FANTASY ISLANDER] should not have been out in the first place" and that the life preservers should have been issued to the passengers at the first sign of trouble, as had been the practice aboard other vessels upon which she had worked. She considered it unwise to have attempted to reach the marina at Fishermen's Village, thereby exposing other vessels in the marina to a fire hazard.

Vessel Information

The FANTASY ISLANDER (EX ALMEDA), O.N. 269476, was a Coast Guard inspected vessel, certificated on October 6, 1983, for coastwide passenger service in the "Gulf of Mexico between Cedar Key, Florida, and Fort Myers, Florida, not more than 20 miles from a harbor of safe refuge, lakes, bays and sounds between Naples, Florida, and Venice, Florida." The certificate specified that, "When operating not more than twelve (12) hours in any twenty-four (24) hour period, the vessel may be operated with: 1-Licensed Operator (and) 1-Deckhand." The vessel was allowed to carry a maximum of 23 passengers coastwise or 38 passengers in lakes, bays, and sounds. The FANTASY ISLANDER was subject to Federal regulations contained at 46 CFR Subchapter T - Small Passenger Vessels (under 100 gross tons) where it is subclassed as an "S" vessel. 3/ (See appendix B.)

3/ "S" vessels are defined as not more than 65 feet in length and of less than 100 gross tons carrying more than 6 passengers for hire.

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The FANTASY ISLANDER was built in 1955 at Moorehead City, North Carolina, as a commercial sport fishing vessel. (See figure 4.) The vessel had not been used for about 2 years before it was purchased by King Fisher Cruise Lines, Inc., in August 1983. The vessel was put into passenger service in October 1983, and at the time of the accident had made over 110 trips.

Plans of the vessel were not available for this investigation. The hull was constructed primarily of juniper wood. Some plywood and fiberglass were used in the cabin construction. The vessel had the following characteristics:

Length	42 feet
Beam	13 feet 10 inches
Draft	3 feet
Gross tons	14
Horsepower	420, twin diesel

Figure 4.--The FANTASY ISLANDER, as the EX ALMEDA.

The FANTASY ISLANDER had a slight V-bottom hull which was subdivided into four unequally sized compartments by a collision bulkhead near the bow, a bulkhead separating the forward passenger cabin from the engine compartment, and a bulkhead at the after end of the engine compartment below the main cabin's after bulkhead. The forward cabin included a toilet, storage compartment, a counter cabinet, and seating for six persons. A ladder provided access through a hatch to the forward deck. A four-step stairway aft led up to the main cabin, located over the engine compartment. The main cabin had two storage compartments, an athwartship table on the starboard side, and seating for 8 persons. A wide doorway aft led to the open cockpit which had athwartship seating for 17 persons. An aluminum framework with a vinyl canopy provided sun protection over most of the cockpit. A ladder led from the cockpit deck to the flying bridge deck. The open-top flying bridge was equipped with a steering and engine control console, a marine radiotelephone, and had seating for 10 persons.

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Four natural draft half-vents 4/ were mounted on the sides of the cabin to ventilate the engine compartment. The two larger forward half-vents faced forward and the two smaller after half-vents faced aft. Additionally, a large aft-facing cowl vent 5/ located on each side of the cockpit between the muffler stack and the main cabin bulkhead vented the space below the cockpit deck. Both diesel fuel tanks, each having a capacity of 65 gallons, had been filled before the vessel departed Fishermen's Village on September 8.

No-smoking signs had been posted about the vessel. Smoking was not allowed inside the cabins but was allowed on outside decks and in the cockpit. The operator testified hat there were no screens on any of the vents and that lighted tobacco products entering the hull compartments through the vents could cause a fire. Federal regulations do not require that these vents be provided with screens.

The FANTASY ISLANDER was powered by twin GM, Model 6V-53 fresh water cooled marine diesel engines. The engines provided a cruising speed of 10 knots. The starboard engine operated at a higher cooling water temperature (180° F to 185° F) than the port engine (155° F to 160° F) but both engines operated within the normal operating temperature range according to the operator.

The engines were equipped with emergency air shutdown levers located at the forward upper end of each engine. The levers were not fitted with devices to allow for remote control shutdown. To cut off the air supply to the engines in an emergency required the opening of the engine compartment hatch to manipulate the emergency shutdown levers.

The engines were fitted with a dry exhaust system which led aft from the engines through the engine compartment after bulkhead and upward through the cockpit deck to two vertical exhaust mufflers. The mufflers were enclosed in 15-inch-square fabricated wood stacks, located about 3 feet aft of the main cabin after bulkhead and near the cockpit port and starboard gunwales. The wooden stacks provided an air space around the mufflers. Lengths of 4-inch-diameter flexible tubings formed into 90 degree bends were used to connect the engine exhaust pipes to the mufflers. The flexible tubing was covered with about 2 1/2 inches of fireproof insulation, wrapped in fiberglass cloth.

The operator testified that a starboard "exhaust overheating" problem had been experienced three or four times since the vessel had been acquired. The heat from the starboard exhaust flexible tubing had caused charring of the wood at the penetration through the engineroom after bulkhead about January or February and again in June 1984. Consequently, he had enlarged the opening in the bulkhead and had added insulation around the flexible tubing most recently in June 1984. He believed the "exhaust overheating" problem had been corrected. The operator testified that the vessel's previous owner had changed the wet exhaust system to a dry exhaust system about 1981 after water from an overtaking wave entered the engines through the system. Because

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4/ A bell or hood-shaped ventilator pipe fitting, cut in half, and mounted on the side of a cabin or the vessel's superstructure. The enlarged bell or hood-shape, when facing the wind, serves to scoop air and accelerate it down the pipe into the compartment to be ventilated.

5/ A bell or hood-shaped ventilator pipe fitting, on the weather deck, making a 90° angle with the pipe and having an enlarged opening to obtain increased air supply when facing the wind. The bell or hand-shape serves to scoop air and accelerate it down the pipe into the compartment to be ventilated. The free standing cowl vent may be rotated to face into or away from the wind.

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the dry exhaust installation created noxious fumes which caused passenger discomfort, the FANTASY ISLANDER's owners had planned to reinstall a wet exhaust system in the vessel. The plans to do so had been approved by the Coast Guard and the installation was to have been accomplished on September 10, 1984, 2 days after the accident.

The FANTASY ISLANDER was equipped with one 15-person lifefloat, positioned on top of the forward cabin, life preservers for 38 adults and 7 children, and one ring life buoy. Fire protection equipment included one Class B I carbon dioxide (CO_2) and three Class B II 6/ fire extinguishers (CO_2), and one hand fire pump with 50 feet of 3/4-inch hose. The vessel was equipped with a 55-channel VHF radiotelephone and an emergency position indicating radio beacon (EPIRB) which were licensed by the Federal Communications Commission (FCC). The USCG last performed a drydock examination and an inspection for certification of the FANTASY ISLANDER on October 6, 1983. As a result of the inspection, the Coast Guard issued the vessel's owners a list of 10 minor deficiencies related to such items as stenciling, cracked portlight glasses, life preserver replacement, firehose replacement, operation of the emergency shutoffs, and posting documents. The deficiencies were corrected. The Record of Inspection showed the FANTASY ISLANDER to be "fit for the service and route specified."

The FANTASY ISLANDER had been inspected by two Coast Guard officials. One was a privately employed Resident Machinery Inspector who held a Coast Guard license as a Chief Engineer; he had 35 years' merchant marine experience and was under contract to the Coast Guard to conduct vessel inspections. The other inspector, a Chief Warrant Officer, Engineering, had 18 years' service in the Coast Guard. Each inspector had inspected at least 50 passenger vessels. The inspection of the FANTASY ISLANDER had required nine man-hours.

The Resident Machinery Inspector testified that he did not recall any evidence of charring or burning from a previous fire aboard the FANTASY ISLANDER. He was unaware that the vessel's engine exhaust system had been changed from a wet to a dry installation. He did not recollect having checked the clearance around the exhaust pipe penetration through the engine compartment wooden after bulkhead. He stated there was no sign of deterioration of exhaust line insulation and, consequently, none was removed during the inspection. He testified that he did not recall any fire hazard on board, and that no problems had been mentioned to him by the operator during the inspection.

The Chief Warrant Officer did not recollect anything unusual about the FANTASY ISLANDER inspection. He stated that it was more difficult to detect problems in dry exhaust systems because of pipe insulation. On the other hand, poor connections, leaks and salt buildups could be readily detected in wet exhaust systems. He did not recall noticing any scorched wood bordering the FANTASY ISLANDER's dry exhaust installation, and he did not find any oil leaks.

Waterway Information

Charlotte Harbor borders the Gulf of Mexico and provides the approach to the Port of Boca Grande and the Peace River. The harbor is protected from the Gulf of Mexico by low offshore barrier islands which are tourist attractions for fishing and vessel cruising. The water depth near the center of the harbor is about 22 feet. The FANTASY ISLANDER's operator said that the water temperature was about 80° F. The site of the

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6/ Class B I--1 1/4-gallon foam, 4 pound CO_2, or 2-pound dry chemical minimum size. Class B II--2 1/2 -gallon foam, 15-pound CO_2, or 10-pound dry chemical minimum size.

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accident is shown on National Oceanic and Atmospheric Administration (NOAA) National Ocean Survey (NOS) Chart 11426; Estero Bay to Lemon Bay, including Charlotte Harbor.

Meteorological Information

The weather conditions as reported at Charlotte County Airport, Punta Gorda, at 1600 on September 8, 1984, showed broken clouds, a visibility of 10 miles, 25-knot winds from 030 degrees true, and the air temperature at 84 °F.

Tests and Research

A portion of the starboard exhaust flexible tubing was removed from the FANTASY ISLANDER for analysis by the Safety Board's Metallurgical Laboratory. (See figure 5.)

Figure 5.--Portion of the starboard exhaust tubing removed from the FANTASY ISLANDER.

The laboratory report showed that the tubing was of "steel having little or no alloying elements. The lack of chromium showed that the materials were not stainless steel." Measurements of the flexible metal tubing found it to be .0464 inch thick, and there were numerous 1/8- to 1/2-inch holes where the metal had rusted. The port side flexible exhaust tubing was of interlocking construction and did not have a similar deterioration.

A sample portion of the insulation removed from around the starboard flexible exhaust pipe was blackened by fire and showed signs of petroleum saturation. The Safety Board's laboratory fire tests of the saturated insulation found it would burn like a wick when ignited.

Survival Factors

It is not known how many of the persons aboard who had to abandon the FANTASY ISLANDER could swim, but they were supportive of one another and were able to stay together clinging to the lifefloat in the warm harbor water. There was no evidence of passenger panic at any time.

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Other Information

Diesel Engines.--The twin GM 6V-53 diesel engines with which the FANTASY ISLANDER was powered are not uncommon. The U.S. Coast Guard uses the engines in some of its boats and has several installed ashore for training personnel. The engine manual 7/ shows that the engine has a normal cooling water operating temperature of 160° F to 185° F, and an exhaust system temperature of 725° F to 880° F, depending on the type of boat installation, i.e., work, crew, or pleasure boat. 8/ Recommended size for exhaust system pipe is 3 1/2-inch-diameter for dual or 5 1/2-inch-diameter for single exhaust installations. Because the Coast Guard experienced a number of fires aboard its vessels due to diesel oil spray from fuel lines leaking or breaking and igniting upon contacting the diesel engine's hot exhaust pipe, it currently uses insulation padding, which is laced in place around the sections of exhaust pipes within the engine compartments to reduce the fire hazard and to protect personnel from contacting the hot pipes.

Diesel engine overspeed or hunting 9/ may occur from a malfunction in the governor mechanism 10/ or the fuel control system. The failure of either may cause difficulty in stopping the engine. An accumulation of lube oil in intake air passages--manifold or air box--also may cause a "runaway" engine over which the governor has no control.

The color of diesel exhaust smoke can be used as a guide in troubleshooting. The exhaust of an efficiently operating engine has little or no color. A dark, smoky exhaust indicates incomplete combustion, and the darker the color the greater amount of unburned fuel in the exhaust. 11/

Engine Exhaust Pipe Installation.--Federal regulations concerned with engine exhaust pipe installations on small passenger vessels are contained in 46 CFR 182.15-20. Additionally, the Standards and Recommended Practices for Small Craft, published by the American Boat and Yacht Council, Inc., (ABYC), Standard P-1 "Safe Installations of Exhaust Systems for Propulsion and Auxiliary Machinery" are accepted by the Coast Guard as meeting the applicable regulations. 12/ (See appendix C.)

Wood in Vessel Construction.--Woods are combustible and will char, smolder, ignite, and burn under certain heat conditions. Normally, self-ignition does not occur; a source of ignition, such as a spark, open flame, contact with a hot surface, or exposure to heat radiation is necessary. However, wood can by pyrolyzed to charcoal, which has a lower ignition temperature.

The ignition temperature of wood depends on many factors, such as size, shape, moisture content, and type. Generally, the ignition temperature of wood is about 204° C (400° F). However, it is believed that 100° C (212° F) is the maximum temperature to which wood can be subjected over a long period of time without self-ignition taking place. The rate of combustion of wood and wood-based materials depends on the physical form of the materials, and its moisture content among other factors. 13/

7/ Detroit Diesel 6V-53N; USCG Reserve Training Center Manual.
8/ Detroit Diesel Allison, Division of General Motors Corp. 6-V53 Marine.
9/ Varying engine speed at a constant control setting.
10/ A speed sensitive mechanism designed to maintain reasonably constant engine speed regardless of load variation.
11/ Bureau of Naval Personnel, Rate Training Manual, NAVPERS 10541-B.
12/ Standards and Recommended Practices for Small Craft, 1983-84, American Boat and Yacht Council, Inc., P.O. Box 806, Amityville, N.Y. 11701.
13/ Marine Fire Prevention, Firefighting and Safety, U.S. Department of Commerce, Maritime Administration; Maritime Training Advisory Board.

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Radio Communication.--Vessels carrying more than six passengers for hire, as well as many other commercial craft, are required to carry radio equipment. The Federal regulations concerning radio installation and use are contained in the Federal Communications Commission (FCC) Rules and Regulations at 47 CFR Parts 81 and 83. The FANTASY ISLANDER was properly equipped and its radio was working satisfactorily on the day of the accident.

The following recommended procedures for sending a distress call and message were excerpted from the Marine Radiotelephone Users Handbook: 14/

DISTRESS CALL AND MESSAGE

Sending Distress Call and Message

First send the Radiotelephone Alarm Signal, if available.

1. Distress signal MAYDAY (spoken three times)
2. The words THIS IS (spoken once)
3. Name of vessel in distress (spoken three times) and call sign (spoken once)

The Distress Message immediately follows the Distress Call and consists of:

4. Distress signal MAYDAY (spoken once)
5. Name of vessel (spoken once)
6. Position of vessel in distress by latitude and longitude or by bearing (true or magnetic, state which) and distance to a well-known landmark such as a navigational aid or small island, or in any terms which will assist a responding station in locating the vessel in distress. Include any information on vessel movement such as course, speed and destination.
7. Nature of distress (sinking, fire, etc.)
8. Kind of assistance desired
9. Any other information which might facilitate rescue, such as:
   length or tonnage of vessel
   number of persons on board and number needing medical attention
   color of hull, decks, cabin, masts, etc.
10. The word OVER

Example: Distress Call and Message

(Send Radiotelephone Alarm Signal, if available, for at least 30 seconds but not more than 1 minute.)

"MAYDAY-MAYDAY-MAYDAY
THIS IS-BLUE DUCK-BLUE DUCK-BLUE DUCK-
WA 1234
MAYDAY-BLUE DUCK
DUNGENESS LIGHT BEARS 185 DEGREES MAGNETIC-
DISTANCE 2 MILES
STRUCK SUBMERGED OBJECT
NEED PUMPS-MEDICAL ASSISTANCE AND TOW
THREE ADULTS-TWO CHILDREN ABOARD
ONE PERSON COMPOUND FRACTURE OF ARM
ESTIMATE CAN REMAIN AFLOAT TWO HOURS
BLUE DUCK IS THIRTY-TWO FOOT CABIN CRUISER-
BLUE HULL-WHITE DECK HOUSE
OVER"

NOTE: Repeat at intervals until answer is received. If no answer is received on the Distress frequency, repeat using any other available channel on which attention might be attracted.

Any message headed by one of the emergency signals (MAYDAY, PAN-PAN, or SECURITY), must be given precedence over routine communications. This means listen. Don't transmit. Be prepared to help if you can. The decision of which of these emergency signals to use is the responsibility of the person in charge of the vessel.

14/ Marine Radiotelephone Users Handbook, Radio Technical Commission for Marine Services (RTCM) in cooperation with the Federal Communications Commission (FCC).

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ANALYSIS

Origin of Fire

The fire on the FANTASY ISLANDER most likely originated in the engine compartment at the after wooden bulkhead when the hot, deteriorated starboard flexible exhaust pipe ignited residual fuel which had leaked through the pipe and saturated surrounding insulation; the burning residual fuel subsequently ignited the wood bordering the bulkhead penetration. Since the bordering wood had been charred earlier and had been subjected to the high heat from the exhaust pipe for a significant period of time, it was readily susceptible to ignition at lower than normal temperature. An examination of the outside of the hull after the accident revealed that there was discoloration of the outside paint from scorched wood in the area of the starboard flexible exhaust pipe. Although the operator had enlarged the opening about the flexible exhaust pipe, the deterioration of the pipe may have allowed the section to sag close to the edge of the enlarged opening. Oil spraying from an undetermined source into the engine compartment and onto the vessel's wooden structure accelerated the spread of the fire which, uncontrolled, rapidly consumed the superstructure of the vessel. The spraying oil could have come from some part of the starboard engine, but more likely came from a fuel line leak. The oil spraying on the hot engine exhaust manifold or the exhaust pipe could have been the initiating cause of the fire, but the development of the fire suggests that this event occurred sometime after the operator initially detected the odor of burning wood at 1500.

Operator's Efforts to Extinguish the Fire

The first indication of the possibility of fire was about 1500 when the operator detected the odor of wood burning which appeared to come from the starboard side of the vessel. The odor was detected about 45 minutes before flames broke out in the engine compartment. Having experienced a prior scorching condition at the starboard exhaustpipe installation and a small fire associated with the starboard exhaust system, the operator should have anticipated the possibility of a similar fire and immediately investigated the source of the fire. Had he done so, he probably could have extinguished the fire and been able to return the vessel safely to its berth without endangering the lives of the passengers. However, instead of immediately investigating the possibility of a fire and extinguishing it at an early stage, the operator opted to continue the trip and to attempt to reach Peace River, where vessels which might assist if necessary were more numerous, or Fishermen's Village, where he would have access to a fire hydrant that was located near the vessel's berth. Moreover, the operator made no early effort to contact Fishermen's Village by radio to alert persons of his vessel's predicament or to request that vessels, including an available fire boat, standby to assist if needed. Meanwhile, the smoldering progressed unchecked while the vessel continued inbound.

Although the vessel was equipped with a hand operated fire pump and hose, which had been used effectively on the previous fire, the equipment was stored disassembled in the forward cabin. And, although the operator had in mind the availability of water at the vessel's berth to put out a fire, he did not order the mate to assemble the fire pump which could have provided water to wet the smoldering wood and prevent ignition. The equipment easily could have been readied for use in the time available before the operator finally decided to investigate the conditions below and well before he opened the engine compartment hatch. However, because he feared passenger panic if they became aware of the possibility of a fire, he assigned the mate to devote her time talking to passengers and keeping them calm. The mate could have explained to the passengers that the pump was being readied as a precaution without causing a panic. Consequently, when the fire did break out, the fire pump which could have been effective on the wood fire was not ready for use.

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When the operator eventually went below to assess the situation, he found life preservers smoldering in the storage cabinet, which indicated that smoldering fire had already spread over a considerable area of the engine compartment after bulkhead. Although he stuffed rags into the starboard side forward half-vent to reduce the inflow of air into the engine compartment, air still was able to enter through the port side forward half-vent, and the temperature was undoubtedly rising within the compartment.

It was a passenger's exclamation that there was a fire, about 1545, which finally prompted the operator to take direct action concerning the fire. The situation then was aggravated by the starboard engine becoming a "runway." Consequently, the operator not only had to be concerned with the fire but also with stopping the starboard engine. Because the engines were not equipped with remote emergency air shutdown controls, the operator had to open the engine compartment hatch to manipulate the engine air shutdown lever, at which time, he felt hot oil being sprayed from an undetermined source in the vicinity of the engine. Had the engines been equipped with remote air shutdown controls which could be activated at the flying bridge control position or some other location outside the engine compartment, the engines could have been stopped more quickly and safely and the operator would not have had to open the engine compartment hatch cover. Valuable time was lost while the operator descended from the flying bridge, opened the hatch, and eventually shut off the fuel line valves in the cockpit; and the starboard engine continued to run for several minutes thereafter.

The oil spray may have been due to a broken fuel line or a fitting loosened by engine vibration. In any event, the oil spray provided additional fuel to support the spread of the fire in the engine compartment. Opening the hatch cover provided a massive inflow of air into the compartment which caused the smoldering wood which may not yet have been burning actively to burst into flame. The operator initially saw flames erupt in the after starboard side of the engine compartment. Although the operator was able to briefly extinguish the fire using CO_2 extinguishers, the fire reignited and then burned out of control as the available CO_2 extinguishers were exhausted of their contents. The CO_2 extinguishers proved insufficient to fight the fire in the wooden structure of the vessel. The Safety Board believes that had the operator taken early action to extinguish the fire by having the mate assemble the hand fire pump so that it could have been used for firefighting, and to shut down the starboard engine, he might have been able to extinguish the fire in its early stage of development.

Fire Protection Equipment

The FANTASY ISLANDER, built in 1955, was required to be in compliance with 46 CFR Part 181 relative to fire protection equipment only "insofar as deemed reasonable and practicable by the Office in Charge, Marine Inspection," because the vessel had been contracted for before June 1958. The vessel was found to be "fit for the service and route specified," according to the Coast Guard inspection conducted on October 6, 1983.

Since the FANTASY ISLANDER was not permitted to carry more than 49 passengers, it was not required to have a power-driven fire pump. The vessel was equipped with the required hand operated fire pump with a capacity of 5 gallons per minute. The vessel's operator described the fire pump as as a "toy," and he believed that a 5-gallon bucket was more useful. That attitude probably contributed to the operator's failure to maintain the fire pump assembled and ready for use or to assemble the equipment after he detected the fire. Unfortunately, the vessel did not have a 5-gallon bucket on board the day of the accident. If the operator/owner of the FANTASY ISLANDER believed that the fire pump required by the Federal regulations was inadequate for the vessel's emergency needs, there is no reason why additional more

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effective equipment could not have been carried or installed, since the regulations prescribe only minimum requirements.

In any shipboard fire incident, early discovery is essential for the protection of passengers, crew, and the vessel. The fire must be confined, controlled, and extinguished in its early stages before it endangers the vessel and the lives of persons on board. In this instance, the fire was allowed to smolder for 45 minutes before action was taken to extinguish it. Promptly used, a 5-gallon bucket of water initially might have been effective in extinguishing the smoldering fire, as might have the 5-gallon per minute capacity hand fire pump.

Diesel Engine Emergency Air Shutdown Control

The FANTASY ISLANDER's GM 6V-53 vessel engines were equipped with emergency air shutdown control levers located at the forward upper end of the engine. However, when the starboard engine became a runaway, the operator had to open the engine compartment to manipulate the emergency control lever to stop the engine. Because he was unable to locate the lever due to the black smoke in the engine compartment, he returned to the cockpit to close the engine fuel oil supply valves. A more rapid procedure on his part would have been to initially close the fuel supply valves since he had to pass by the valves before entering the cabin. This procedures would have expedited the engine shutdown, eliminated the need to open the hatch cover, and prevented the massive flow of air into the engine compartment which assisted combustion.

Had the diesel engines been equipped with remote emergency air shutdown controls which could have been activated from outside the engine compartment, preferably at the flying bridge, valuable time might have been saved in stopping the runaway engine and the procedure would have been safer. However, Federal regulations do not require such remote controls to be installed.

Diesel Engine Dry Exhaust System

Federal regulations and the ABYC standards address the installation and the materials to be used in a diesel engine dry exhaust system; the installation on the FANTASY ISLANDER was in compliance. However, the installation had been made before 1983 when King Fisher Cruise Lines, Inc., acquired the vessel. The vessel had experienced wood scorching and a small fire since it was purchased, but these incidents were not significant enough to require a report to the Coast Guard under the requirements of 46 CFR 185.15-1. The operator did not mention any incidents to the Coast Guard inspectors nor was he required to. Had he done so, however, the inspectors might have conducted a more thorough inspection of the exhaust pipe installation in the vicinity of the scorching.

The condition of the flexible exhaust pipe was not readily apparent to the Coast Guard inspectors because the pipes were covered with fixed insulation. The removal of such insulation would have been difficult, time consuming, and caused some inconvenience and replacement expense to the operator. Since the Coast Guard inspectors detected no apparent problems and were not apprised by the vessel's operator of the scorching of the engine compartment's wooden after bulkhead, they assumed that the exhaust installation was in good condition. However, the investigation of the starboard flexible exhaust pipe after the accident revealed that the pipe had 1/8- to 1/2-inch holes caused by rust wasting away the metal. Once the holes had developed in the flexible exhaust piping, unburned fuel leaked out and permeated the exhaust pipe insulation, and high exhaust temperatures could cause ignition of the residual fuel.

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Easily removed insulation materials are available on the market for use on dry exhaust systems. The use of such insulation would allow regular inspection of exhaust systems without causing vessel operators significant inconvenience. Removable inspection plates also could be installed at suitable locations along the exhaust pipe runway where ready physical access is not possible such as the cockpit deck and the exhaust stack casing aboard the FANTASY ISLANDER. Such inspection plates would allow a more thorough inspection to be conducted.

Passenger Safety

The FANTASY ISLANDER's passengers were informed by the operator concerning the vessel's lifesaving devices and their location shortly after the vessel left its berth at Fishermen's Village. However, on the return trip when the operator detected the odor of burning wood, he did not have the passengers don life preservers or even remove them from their stowed positions so that they would be readily available if needed. The operator appeared to be more concerned that the passengers would panic if they became aware of the fire. However, even after the operator found that about 11 life preservers had been made useless by the fire, he still did not issue the remaining life preservers to the passengers.

Although the passengers had been briefed concerning the vessel's safety devices, they did not of their own volition obtain or don life preservers when the fire first erupted. Consequently, the passengers were not wearing life preservers when they abandoned the vessel, and neither was the crew. The rapidity with which the fire spread after it broke out quickly prevented access to the stowed life preservers. Had the life preservers been more widely distributed about the passenger seating locations at least some of them would have been accessible for use.

Passengers tend to rely on vessel operators and crewmembers to advise them when to obtain or don life preservers. While some of the passengers sensed there was danger and made their feelings known to the mate, they did not anticipate the events that followed. Only a few passengers may have experienced a fire ashore and fewer still may have experienced a fire at sea which could have prepared them to cope with this accident. This accident again illustrates that even though a vessel is in relatively protected waters an accident can rapidly lead to disastrous results. Because of the few crewmembers relative to the number of passengers carried on small passenger vessels, the crew may not have time to advise passengers of actions they should take in a rapidly developing emergency. Further, during an emergency, crewmembers may become more preoccupied with saving the vessel and neglect assisting passengers. For these reasons, the Safety Board believes that Coast Guard inspectors, during the inspection of small passenger vessels, should consider whether the life preservers are distributed widely enough when stowed so as to be readily accessible to individual passengers during an emergency.

Primary Lifesaving Equipment

The FANTASY ISLANDER was equipped with a 15-person lifefloat as required by its certificate of inspection. However, the lifefloat's capacity was not sufficient to have accommodated all 37 embarked persons after they abandoned the vessel without life preservers. Had it not been for the timely arrival of the SHARING SHIP, and the walk-aboard transfer while the FANTASY ISLANDER was being abandoned, several persons might have drowned.

Although the FANTASY ISLANDER was operating during daylight in warm, relatively protected waters in which vessels which might render assistance generally were present, such conditions are not always the case in an emergency. At night, for example, it is much more difficult to locate persons in the water. Currently, an increasing number

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of passengers of various ages, with limited or no marine experience are boarding a variety of small passenger vessels on fishing trips, ferry trips and a variety of cruises, a sightseeing/luncheon cruise in this instance. Passengers assume that the vessel on which they are traveling is safe, that the crew is competent, and that they will be appropriately advised what to do in the event of trouble. Unfortunately, these assumptions may not be correct. Passengers could be oblivious to danger until they are in the water, contemplating how they got there.

The FANTASY ISLANDER was required by 46 CFR 180.10-20 to carry sufficient lifeboats or buoyant apparatus for not less than 30 percent of all persons on board while operating in lakes, bays, and sounds. The 15-person lifefloat on board would have accommodated 4 persons in excess of the 11-person minimum requirement, based on the persons on board for the trip. Therefore, 22 persons without life preservers would not have had flotation support if help had not been available.

The Safety Board, in its investigation of the U.S. Passenger Vessel M/V YANKEE, 15/ expressed its concern about the "adequacy and accessibility of primary lifesaving equipment in a worse-case situation" and recommended that the Coast Guard:

> Reevaluate 46 CFR 75.10-20(a) to determine whether the primary lifesaving equipment required is adequate to safely support the entire crew and maximum embarked passengers in the water pending arrival of search and rescue assistance and amend the regulations, as necessary, to eliminate deficiencies in prescribed primary lifesaving equipment. (Class II, Priority Action) (M-84-29)

On February 26, 1985, the Coast Guard replied that:

> This recommendation is concurred with in part. The Coast Guard continually evaluates its lifesaving regulations to ensure that adequate protection is afforded to all persons on board. One area currently being evaluated is whether a reduction in lifesaving requirements for the summer season should be based on calendar date or on the prevailing water temperature in the operating area.
>
> However, the Coast Guard determined that the regulation delineating the amount of primary lifesaving equipment required on board should not be amended. Since the casualty occurred in July, persons in the water probably would not be subjected to an immediate threat from hypothermia. In addition, there were numerous other vessels close by that could have provided assistance quickly.

The Safety Board responded that the requirements for primary lifesaving devices on passenger carrying vessels of this type should be determined without regard to the temperature of the water. The threat of hypothermia is but one consideration in the event of an accident. Had the YANKEE sunk, many passengers would have been forced into the water without adequate lifesaving devices at their disposal. The Safety Board believes that sufficient primary lifesaving equipment should be required on board for all passengers and crewmembers authorized to be embarked on passenger carrying vessels, without regard to water temperature. Therefore, Safety Recommendation M-84-29 has been classified as "Open--Unacceptable Action." The Safety Board has asked the Coast Guard to reconsider its position on this matter.

15/ Marine Accident Report—"Collision of the U.S Passenger Vessel M/V YANKEE and the Liberian Freighter M/V HARBEL TAPPER in Rhode Island Sound, July 2, 1983" (NTSB/MAR-84/05).

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When the charter fishing boat JOAN LA RIE III 16/ capsized off Manasquan, New Jersey, both crewmembers and 4 of the 20 passengers on board were lost. None of the persons on board was wearing a life preserver, and the life preservers stowed in the cabin became inaccessible. The vessel was certificated for 37 persons and carried primary lifesaving equipment for 22 persons. By coincidence, there were only 22 persons on board on the day of the accident. The Safety Board finds that the FANTASY ISLANDER accident further illustrates a need for the Coast Guard to reconsider the adequacy of primary lifesaving equipment on 46 CFR Subchapter T passenger vessels in all operating areas.

Radiotelephone Communications

The FANTASY ISLANDER's operator had 5 years' experience in the Coast Guard Auxiliary, including 4 years working with the Coast Guard in search and rescue operations. Since an accurate distress message is crucial to the initiation of a search and rescue response, the operator should have made the distress broadcast or instructed the mate specifically of the message to be sent. Because the operator was directing the passengers, however, he allowed the mate to initiate the distress message. The mate, however, instead of broadcasting a distress message, transmitted a general message to the Fishermen's Village radio station concerning the plight of the FANTASY ISLANDER, and requested assistance. Because the mate did not broadcast a proper Mayday on VHF channel 16, which immediately would have alerted the Coast Guard and vessels within receiving range to the FANTASY ISLANDER's distress, the urgency of the transmission was not evident. Vessels in the area continued to transmit routinely on channel 16 instead of listening, as required in the event of a Mayday broadcast. The mate described the location of the FANTASY ISLANDER as being off Colony Point. But, Colony Point is not shown on the navigation chart of the area. Consequently, vessel operators who received the message began to request information as to the location of Colony Point thereby interrupting communications and causing a delay in vessel response to the distress. Also, the mate did not specify the number of passengers aboard. Such information would have emphasized the gravity of the distress involving a fire. The information is important to the Coast Guard for determining the number and types of units needed to respond effectively to the situation.

Although the operator of the SHARING SHIP broadcast a Mayday at 1559, while en route to assist the FANTASY ISLANDER, he did not identify his vessel or provide other pertinent information before he dropped the microphone, thereby terminating his broadcast. The Mayday broadcast was received by the Coast Guard Station at Fort Myers Beach, Florida, over 30 nmi distant, but Coast Guard followup concerning the FANTASY ISLANDER's predicament was delayed as a consequence of the SHARING SHIP's incomplete message. Had the SHARING SHIP not been close to the accident site the delay might have had serious consequences.

The Safety Board is concerned that communication practices continue to be a significant factor in accidents. The mate's broadcast illustrated a lack of knowledge of the correct radiotelephone procedures to be used when making a distress broadcast. However, since the mate was not required to be licensed or certificated by the Coast Guard or the FCC and lacked experience, her lack of knowledge of radio communications procedures is understandable. Since a proper distress message is crucial to obtaining

16/ Marine Accident Report--"Sinking of the Charter Fishing Boat JOAN LA RIE III off Manasquan Inlet, New Jersey, on October 24, 1982" (NTSB/MAR-84/02).

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rapid, adequate assistance in an emergency, the Safety Board believes that a placard containing pertinent information as to the content of a proper distress message should be maintained near the radio transmitter to aid the person initiating a distress broadcast in providing pertinent information concerning the vessel involved and the nature of the distress.

CONCLUSIONS

Findings

1. The lack of remote emergency air shutdown controls on the FANTASY ISLANDER delayed shutdown of the runaway diesel engine.

2. The origin of the oil spray in the vicinity of the starboard diesel engine could not be determined.

3. The available CO_2 extinguishers proved insufficient to control the wood structural fire of the vessel once the fire was not confined to a closed compartment.

4. Had the FANTASY ISLANDER's hand operated fire pump been maintained assembled and ready for use, it might have been used effectively in fighting the fire.

5. Water buckets would have been useful in fighting the wood fire, but none were carried on this trip.

6. The scope of the Coast Guard inspection of vessels, such as the FANTASY ISLANDER, would not detect deterioration in exhaust pipe hidden by fixed insulation.

7. Had the dry exhaust piping on the FANTASY ISLANDER been encased in removable insulation, a more effective inspection could have been conducted and the deteriorated pipe condition could have been detected.

8. Had the FANTASY ISLANDER's operator immediately investigated the source of fire when he first detected the odor of smoldering wood, he probably could have extinguished the fire while it was controllable and saved the vessel.

9. The FANTASY ISLANDER operator's decision to attempt to reach Fishermen's Village rather than to investigate the fire immediately was imprudent under the circumstances, and needlessly endangered the passengers.

10. Had the FANTASY ISLANDER's operator broadcast a message earlier to alert persons about the fire on board his vessel, responding vessels could have been on scene sooner and the outcome of the accident might have been less severe.

11. The failure of the FANTASY ISLANDER's operator to have the passengers don life preservers early needlessly endangered them when the fire broke out and made the stowed life preservers inaccessible.

12. The primary lifesaving equipment required to be carried on small passenger vessels, such as the FANTASY ISLANDER, is not sufficient to provide flotation for all persons on board if they must abandon the vessel without donning life preservers.

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13. Had it not been for the timely arrival alongside of the SHARING SHIP, several persons might have drowned when the FANTASY ISLANDER had to be abandoned.

14. Because the FANTASY ISLANDER's mate did not send a proper Mayday broadcast on VHF channel 16, the urgency of the message sent was not evident and valuable time was lost when prompt assistance was urgently needed.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the destruction by fire of the FANTASY ISLANDER was the failure of the operator to investigate immediately when he detected the odor of burning wood and to take early measures to extinguish a smoldering fire in fuel soaked insulation. The leakage of residual fuel into the surrounding insulation and its ignition were caused by undetected deterioration of the flexible piping in the dry exhaust system. Contributing to the spread of the fire was the failure of the operator to shut down the starboard engine immediately when he detected fire, oil spray from an undetermined source in the vicinity of the starboard engine which fueled the fire, and the operator's failure to use all available firefighting equipment to confine and control the fire.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board recommended that the U.S. Coast Guard:

Require that insulation used on dry exhaust pipe installations on small passenger vessels be removable so that the pipe can be more readily examined during inspections and deterioration detected. (Class II, Priority Action) (M-85-83)

Require more stringent inspection of dry exhaust piping installations on small passenger vessels, and include in the Inspection Books an appropriate check-off item for this purpose. (Class II, Priority Action) (M-85-84)

Require on small passenger vessels that emergency air shutdown controls on diesel engines be remotely operable from outside the engine compartment, preferably at the control station. (Class II, Priority Action) (M-85-85)

Require that required fire protection equipment on small passenger vessels be maintained assembled and ready for immediate use. (Class II, Priority Action) (M-85-86)

Conduct a one-time survey during the next inspection of small passenger vessels of life preserver stowage and, where appropriate, direct changes in stowage to provide individual passengers on deck easy access to life preservers in an emergency. (Class II, Priority Action) (M-85-87)

Amend 46 CFR 180.10 to require that the primary lifesaving equipment carried on small passenger vessels be adequate to safely support in the water 100 percent of the authorized number of passengers and crewmembers pending the arrival of assistance. (Class II, Priority Action) (M-85-88)

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Require that small passenger vessels install a placard near the radio transmitter containing vessel information to be used when initiating a distress broadcast. Verify during inspections of radio equipment that the placard is in place and currently updated, and that vessel operators are familiar with radio distress procedures to be used in an emergency. (Class II, Priority Action) (M-85-89)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G. H. PATRICK BURSLEY
Member

July 30, 1985

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APPENDIXES

APPENDIX A

CREW INFORMATION

Operator

Richard Cernoch, 45, began boating at age 11. He held a U.S. Coast Guard License to operate passenger carrying vessels of not more than 100 gross tons upon the Gulf of Mexico not more than 100 miles offshore between Tampa, Florida, and Everglades City, Florida, dated February 25, 1981. He had served on the 110-foot M/V SEA QUEEN as a mate, and was employed as a boat captain in 1981. He had experience on vessels providing night dinner and dance cruises out of Fishermen's Village on a regular route to Boca Grande. He also had worked in Florida for the past 14 years buying, selling, refurbishing, and rebuilding boats. He had been a member of the Coast Guard Auxiliary for 5 years and had 4 years' experience working with the Coast Guard in search and rescue operations.

Mate

Lori J. Anderson, 21, was not licensed and held no seaman's document issued by the Coast Guard. There is no regulation requiring such documents to be held by a person serving as a crewmember or mate aboard a vessel, such as the FANTASY ISLANDER. The mate had been employed with King Fisher Cruise Lines, Inc. since October 1983, working first part-time and then a full 7-day week during the heavy tourist season which extended from January through Easter. She had about 4 years' experience on sport and commercial fishing boats, and on private boats, including sailboats, ranging from 20- to 50-feet in length. The mate had no formal training in small boat operation. She stated that she had had a full night of rest before the accident.

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APPENDIX B
EXCERPTS FROM 46 CFR 175-187
SUBCHAPTER T -- SMALL PASSENGER VESSELS
(UNDER 100 GROSS TONS)

Subpart 175.05—Application

§ 175.05-5 Specific application noted in text.

(a) S: Under the designator "S" shall be included all vessels indicated in column 4 of Table 175.05-1(a) that are not more than 65 feet in length and of less than 100 gross tons carrying more than six passengers.

(c) Certain portions of this subchapter applicable to only "S" vessels are indicated by the designator "S". Portions applicable to only "L" vessels are indicated by the designator "L". Those portions of this subchapter applicable to both categories of vessels contain no designator or are designated "S and L".

(d) At the beginning of the various parts, subparts and sections, a more specific application is generally given for the particular portion of the text involved. This application sets forth the types, sizes, services or vessels to which the text pertains, and in many cases limits the application of the text to vessels contracted for before or after a specific date.

(e) As used in this subchapter the term "vessels contracted for" includes not only contracting for the construction of a vessel, but also contracting for a material alteration to a vessel, contracting for the conversion of a vessel to a passenger vessel, and changing of service or route of a vessel, if such change increases or modifies the general requirements for the vessel or increases the hazards to which it might be subjected.

Subpart 175.20—Administrative Procedure

§ 175.20-1 Assignment of marine inspector.

(a) Upon receipt of a written application for inspection, the Officer in Charge, Marine Inspection, will assign a marine inspector to inspect the vessel. This inspection will be made at a mutually agreed to time and place.

(b) The owner or someone representing the owner shall be present during the inspection.

§ 175.20-5 Notice of deficiencies and requirements.

(a) If during the inspection of a vessel, the vessel or its equipment is found not to conform to the requirements of law or the regulations in this subchapter, the marine inspector will point out all deficiencies and will discuss all requirements with the owner or his representative. Normally, the marine inspector will list all such requirements which have not been completed and present the list to the owner or his representative.

(b) In any case where the owner of a vessel or his representative desires further clarification of, or reconsideration of any requirement placed against his vessel, he may discuss the matter with the Officer in Charge, Marine Inspection.

Subpart 176.30—Limitations of Inspections

§ 176.30-1 Marine inspector not limited.

(a) Nothing in this part shall be construed as limiting the marine inspector from making such tests or inspections as are reasonable and practicable to be assured of the seaworthiness of the vessel.

Subpart 175.25—Special Consideration

§ 175.25-1 By Officer in Charge, Marine Inspection.

(a) In applying the provisions of Parts 177, 178, 180, 181, 182, 183, and 184 of this subchapter, the Officer in Charge, Marine Inspection, may give special consideration to departures from the specific requirements when special circumstances or arrangements warrant such departures.

Subpart 175.27—Adoption of Standards and Specifications

§ 175.27-1 General.

(a) In this subchapter portions or the entire text of certain industrial standards and specifications are referred to as the governing requirements for materials, equipment, tests, or procedures to be followed. These standards and specification requirements specifically referred to in this subchapter shall be the governing requirements for the subject matters covered unless specifically limited, modified, or replaced by other regulations in this subchapter.

(b) As used in this subchapter references to industry standards, such as those established by the American Bureau of Shipping, Lloyd's Register of Shipping or other recognized classification society, and others, mean that the Coast Guard uses such standards as a guide with respect to the subjects covered, and under normal conditions will accept machinery, etc., meeting the requirements of such standards. Such standards are not adopted as the governing requirements and made a part of the regulations in this subchapter by reference.

(c) In this subpart are listed the organizations publishing standards and specifications which are adopted by reference. The standards and specifications may be obtained direct from the organization issuing the standard or specification.

§ 175.27-5 American Boat and Yacht Council, Inc. (ABYC).

(a) The materials as referenced in this subchapter from standards published by the American Boat and Yacht Council, Inc., in effect on the date equipment is manufactured, are adopted and shall form a part of the regulations in this subchapter. Copies of the referenced materials may be obtained from the American Boat and Yacht Council, Inc., 420 Lexington Avenue, New York, N.Y. 10017.

PART 180—LIFESAVING EQUIPMENT

Subpart 180.10—Primary Lifesaving Equipment Required

§ 180.10-1 General.

(a) All life floats and buoyant apparatus shall be of approved types.

(b) The term "primary lifesaving equipment" means a lifeboat or an acceptable substitute. The acceptable substitute may include liferafts, lifefloats, rescue boats, and buoyant apparatus under certain conditions. Life preservers and ring buoys are not included in the definitions of "primary lifesaving equipment."

§ 180.10-5 Requirements for vessels in ocean or coastwise service.

(a) Except as otherwise provided in this section, vessels in ocean service shall carry sufficient life floats for all persons on board, and vessels in coastwise service shall carry sufficient life floats or buoyant apparatus for all persons on board.

(1) Vessels whose routes are restricted to 20 miles from a harbor of safe refuge shall carry life floats or buoyant apparatus for not less than 50 percent of all persons on board.

(2) For vessels operating not more than one mile from land, the Officer in Charge, Marine Inspection, may permit operation with reduced amounts of life floats or buoyant apparatus when in his opinion it is safe to do so. In permitting such reduction the Officer in Charge, Marine Inspection, shall consider the vessel, its scope of operation and the hazards of the route.

(b) After July 1, 1968, all lifefloats and buoyant apparatus shall be international orange in color.

§ 180.10-20 Requirements for vessels in lakes, bays, and sounds service.

(a) Except as otherwise provided in this section, vessels in lakes, bays, and sounds service shall carry sufficient life floats or buoyant apparatus for not less than 30 percent of all persons on board.

(1) Vessels navigating not more than 1 mile from land are not required to carry life floats or buoyant apparatus.

(b) After July 1, 1968, all lifefloats and buoyant apparatus shall be either international orange or white in color.

Subpart 180.25—Life Preservers

§ 180.25-10 Distribution and stowage.

(a) Life preservers shall be distributed through the upper part of the vessel in protected places convenient to the persons on board.

(b) If practicable, life preserver containers shall be so designed as to allow the life preservers to float free.

(c) Life preservers for children, when provided, shall be stowed separately.

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PART 181—FIRE PROTECTION EQUIPMENT

Subpart 181.01—Application and Intent

§ 181.01-1 Application.

(a) The provisions of this part shall apply to all vessels except as specifically noted in this part.

(b) Installations of power fire pumps, fire main systems and fixed fire extinguishing systems on vessels contracted for before June 1, 1958, shall meet the requirements of this part insofar as deemed reasonable and practicable by the Officer in Charge, Marine Inspection.

§ 181.01-5 Intent.

(a) The intent of this part is to insure that each vessel is provided with safe, readily available and sufficient firefighting equipment of the type necessary to extinguish any fires which are likely to be encountered in normal operation. Due consideration will be given to hazards caused by the vessel's type of fuel, construction material, equipment, cargo, etc.

Subpart 181.05—Approved Fire Protection Equipment

§ 181.05-1 General.

(a) Where equipment in this part is required to be of an approved type, such equipment requires the specific approval of the Commandant.

(b) Notifications regarding approvals are published in the FEDERAL REGISTER, and in addition are contained in Coast Guard publication CG-190, "Equipment Lists".

§ 181.05-5 Equipment installed but not required.

(a) Except as further modified in this section, where fire extinguishing systems or equipment are not required, but are installed, the system or equipment and its installation shall meet the requirements of this part. However, the Commandant may, after suitable investigations and tests, accept fire fighting equipment, which is of a type not contemplated by the regulations in this part, if the safety of the vessel is materially improved thereby.

Subpart 181.10—Fire Pumps

§ 181.10-1 Power fire pump.

(a) *S and L.* A power-driven fire pump shall be installed on each mechanically propelled "S" vessel which is a ferry vessel or which is permitted to carry more than 49 passengers, and on each mechanically propelled "L" vessel.

(b) *S.* The power fire pump shall be selfpriming and of such size as to discharge an effective stream from a hose connected to the highest outlet.

(c) *L.* The minimum capacity of the power fire pump shall be 50 gallons per minute at a pressure of not less than 60 pounds per square inch at the pump outlet. The pump outlet shall be fitted with a pressure gage.

(d) *S.* The power fire pump may be driven off a propulsion engine or other source of power and shall be connected to the fire main. This pump may also be connected to the bilge system so that it can serve as either a fire pump or a bilge pump as described in Subpart 182.25.

(e) *L.* The power fire pump may be driven off one of the propulsion engines in a twin engine installation. In a single engine propulsion installation, the pump shall be driven by a source of power independent of the propulsion engine. The pump may also be connected to the bilge system so that it can serve as either a fire pump or a bilge pump as described in Subpart 182.25 of this subchapter.

§ 181.10-5 Hand fire pumps.

(a) All vessels shall be provided with a hand operated portable fire pump having a capacity of at least 5 gallons per minute. This fire pump shall be equipped with suction and discharge hose suitable for use in fire fighting.

(b) The hand portable fire pump may also serve as a bilge pump.

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PART 182—MACHINERY INSTALLATION

§ 182.15-15 Gasoline engine exhaust cooling.

(a) Except as otherwise provided in this paragraph, all engine exhaust pipes shall be water cooled.

(1) Dry pipe vertical exhausts are permissible if suitably insulated.

(2) Horizontal dry exhaust pipes are permitted only if: They do not pass through living or berthing spaces, they terminate above the deepest load waterline and are so arranged as to prevent entry of cold water from rough or boarding seas, and they are constructed of corrosion resisting material at the hull penetration.

(3) Exhaust pipes on air cooled engines need not be water cooled but suitable insulation may be required.

(b) The exhaust pipe cooling water system shall be in accordance with the following provisions:

(1) Water for cooling the exhaust pipe shall be obtained from the engine cooling water system or a separate engine driven pump.

(2) Water for cooling the exhaust pipe, other than a vertical exhaust, shall be injected into the exhaust system as near to the engine manifold as practicable. The water shall pass through the entire length of the exhaust pipe.

(3) That part of the exhaust system between the point of cooling water injection and the engine manifold shall be water-jacketed or effectively insulated.

(4) Vertical exhaust piping must be water-jacketed or suitably insulated between the engine manifold and the spark arrester.

(5) When the exhaust cooling system is separate from the engine cooling system, a suitable warning device shall be provided to indicate any failure of water flow in the exhaust cooling system. Such warning shall be visible or audible at the engine operating station.

(6) A suitable hull strainer shall be installed in the circulating water intake line for the exhaust cooling system.

(c) Engine exhaust cooling systems built in accordance with the requirements of American Boat and Yacht Council, Inc., Standard P-1, "Safe Installation of Exhaust Systems for Propulsion and Auxiliary Machinery" will be considered as meeting the requirements of this section. (See § 175.27-5 of this subchapter.)

§ 182.15-20 Gasoline engine exhaust pipe, installation.

(a) Exhaust piping shall be led to the point of escape with a minimum number of bends or elbows. It shall be gastight throughout its length and shall be properly supported by noncombustible hangers or blocks.

(b) The exhaust piping shall be so arranged as to prevent backflow of water from reaching engine exhaust ports under normal conditions.

(c) Where flexibility is necessary a section of flexible metallic hose may be used. Non-metallic hose may be used provided it is especially adapted to resist the action of oil, acid and heat, and has a wall thickness sufficient to prevent collapsing or panting.

(d) Where exhaust piping passes through watertight bulkheads the watertight integrity of the bulkhead shall be maintained. Non-combustible packing shall be used in bulkhead penetration glands. Water cooled exhaust pipes may be welded to steel bulkheads in way of penetrations if suitable arrangements are provided to relieve the stresses resulting from the expansion of the exhaust piping.

(e) Where exhaust piping passes through non-watertight combustible bulkheads or partitions non-combustible packing shall be used in bulkhead penetration glands or a minimum clearance of 2 inches shall be provided between the exhaust pipe and the bulkhead or partition.

(f) Vertical exhaust systems shall be provided with spark arresters. Spark arresters shall be supported by suitable steel hangers and shall be lagged with fire resistant material. A clearance of at least 9 inches shall be maintained between the spark arrester and any woodwork.

(g) Protective gratings shall be provided at such locations where persons or gear might come in contact with the exhaust pipe.

(h) Arrangements shall be made to provide access to the exhaust pipe throughout its length.

(i) All exhaust installations with pressures in excess of 15 pounds per square inch gage or employing runs passing through living or working spaces shall meet the material requirements of Part 56 of Subchapter F (Marine Engineering) of this chapter.

(j) Engine exhaust installations built in accordance with the requirements of American Boat and Yacht Council, Inc., Standard P-1, "Safe Installations of Exhaust Systems for Propulsion and Auxiliary Machinery" will be considered as meeting the requirements of this section. (See § 175.27-5 of this subchapter.)

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Subpart 185.15—Notice of Marine Casualty and Voyage Records

§ 185.15-1 Notice of casualty.

The owner, agent, master or person in charge of a vessel involved in a marine casualty shall give notice as soon as possible to the nearest Coast Guard Marine Safety or Marine Inspection Office whenever the casualty involves any of the following:

(a) All accidental groundings and any intentional grounding which also meets any of the other reporting criteria or creates a hazard to navigation, the environment, or the safety of the vessel;

(b) Loss of main propulsion or primary steering, or any associated component or control system, the loss of which causes a reduction of the maneuvering capabilities of the vessel. Loss means that systems, component parts, sub-systems, or control systems do not perform the specified or required function;

(c) An occurrence materially and adversely affecting the vessel's seaworthiness of fitness for service or route, including but not limited to fire, flooding, or failure or damage to fixed fire extinguishing systems, lifesaving equipment, auxiliary power generating equipment, or bilge pumping systems;

(d) Loss of life;

(e) Injury causing a person to remain incapacitated for a period in excess of 72 hours;

(f) An occurrence not meeting any of the above criteria but resulting in damage to property in excess of $25,000. Damage cost includes the cost of labor and material to restore the property to the service condition which existed prior to the casualty, but does not include the cost of salvage, cleaning, gas freeing, drydocking or demurrage.

(g) Vessels are excluded from the requirements of § 4.05-1 (d) and (e) with respect to the death or injury of shipyard or harbor workers when such accidents are not the result of either a vessel casualty (e.g. collision) or a vessel equipment casualty (e.g. cargo boom failure) *and* are subject to the reporting requirements of OSHA under 29 CFR Part 1904.

§ 185.15-5 Substance of marine casualty notice.

The notice required in § 185.15-1 must include the name and official number of the vessel involved, the name of the vessel's owner or agent, the nature and circumstances of the casualty, the locality in which it occurred, the nature and extent of injury to persons, and the damage to property.

§ 185.15-10 Report by person in charge of vessel.

(a) In addition to the notice required by § 185.15-1, the person in charge of the vessel shall, as soon as possible, report in writing to the Officer in Charge, Marine Inspection, at the port in which the casualty occurred or nearest the port of first arrival. The written report required for vessel or personnel accidents shall be made on Form CG-2692. (b) If filed without delay, the Form CG-2692 may also provide the notice required by § 185.15-1.

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APPENDIX C

EXCERPT FROM AMERICAN BOAT AND YACHT COUNCIL, INC. STANDARDS AND RECOMMENDED PRACTICES FOR SMALL CRAFT 1983-84

P–1.5. *MATERIALS*

a. Materials used in an engine exhaust system shall be resistant to salt-water corrosion, shall be galvanically compatible and shall be resistant to exhaust products, especially in the case of diesel-engine exhausts containing appreciable amounts of sulphur.

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b. Materials used shall be in accordance with Table I and are listed in the order of their desirability. Those indicated with asterisks have limited service lives and will require frequent inspection.

P–1.7. *DRY EXHAUST SYSTEMS*

Because of the high temperatures involved in a dry exhaust system, it is imperative that all parts of the system be well insulated from any combustibles and equipped with protective guards to prevent injury to personnel (see Figure 2).

a. Dry exhausts shall not come in direct contact with wooden bulkheads or other combustible materials. A clearance of 9" shall be maintained between the exhaust and any combustible material unless protected by suitable insulation. Where used, the insulating material shall be suitable for the temperatures involved and of sufficient thickness to prevent the surface of the insulation from reaching a temperature in excess of 71°C. (160°F.).

b. The exhaust system shall be so arranged that there is free circulation of air over it.

c. Provision for drawing off rain water entering the exhaust pipe shall be made, either by installing a drain in the silencer or by putting a tee connection in the exhaust pipe.

d. That section of the exhaust between the manifold and the silencer should be water-jacketed, but may be dry if adequately shielded or covered to prevent injury to personnel. The use of a metallic bellows-type section is recommended where a water-jacketed section is not possible.

e. The exhaust piping, silencers and other parts of the system shall be supported throughout the length of the system to prevent vibration failure at the manifold.

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Table 1

TABLE I

Components	GASOLINE ENGINES				DIESEL ENGINES			
	Wet Exhaust		Dry Exhaust		Wet Exhaust		Dry Exhaust	
Exhaust Pipe	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)
	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)
	Nickel-Copper	(3)	Stainless Steel	(8)	Nickel-Copper	(3)	Stainless Steel	(8)
	Copper-Nickel	(4)	Carbon Steel	(9)	Copper-Nickel	(4)	Carbon Steel	(9)
	Fiberglass	(10)			Fiberglass	(10)		
	Rubber Hose	(5)			Rubber Hose	(5)		
	Brass Pipe	(6)			Galv. Wrought Iron	(*)		
	Copper Tubing	(7)			Galv. Steel	(*)		
	Enameled Steel	(*)						
	Galv. Wrought Iron	(*)						
	Galv. Steel	(*)						
Silencer	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)
	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)
	Nickel Copper	(3)	Stainless Steel	(8)	Nickel-Copper	(3)	Stainless Steel	(8)
	Copper	(7)	Carbon Steel	(9)	Fiberglass	(10)	Carbon Steel	(9)
	Fiberglass	(10)			Enameled Steel	(*)		
	Enameled Steel	(*)			Cast Iron	(*)		
	Cast Iron	(*)						
Engine Flex.	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)	Nickel-Iron-Chrome	(1)
	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)	Nickel-Iron-Chrome	(2)
	Nickel-Copper	(3)	Stainless Steel	(8)	Nickel-Copper	(3)	Stainless Steel	(8)
	Copper-Nickel	(4)	Carbon Steel	(9)	Copper-Nickel	(4)	Carbon Steel	(9)
	Copper	(7)						
	Rubber Hose	(5)						
Pipe Conn.	Rubber	(5)	Screwed or Flanged		Rubber	(5)	Screwed or Flanged	

(1) 40. Ni., 21. Cr., 31. Fe., 3. Mo., 1.75 Cu., 0.60 Mn., 0.40 Si., 0.05 C.
(2) 29. Ni., 20. Cr., 44. Fe., 2. Mo. (min.), 3. Cu. (min.), 0.75 Mn., 1. Si., 0.07 C.
(3) 70. Ni., 30. Cu.
(4) 70. Cu., 30. Ni., 0.75 Fe. or 90. Cu., 10. Ni., 1.5 Fe.
(5) See ABYC P-1.6.f., Flexible Hose Connections.
(6) 85. Cu., 15. Zn.
(7) Minimum recommended: Type M copper.
(8) Type 316 low carbon; for temperatures above 482°C. (900°F.)
(9) For temperatures below 482°C. (900°F.)
(10) Shall be CERTIFIED for marine use.
(*) Limited life.

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